



The AV-8B Team Learns Synergy of EVM and TSP Accelerates Software Process Improvement

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This article is a continuation of the success story published in the September 2002 issue of CROSSTALK titled "AV-8B's Experience Using TSP to Accelerate SW-CMM Adoption" [1]. The original article shared AV-8B's lessons learned in achieving the Capability Maturity Model® for Software (SW-CMM®) Level 2 maturity in just 14 months. This article continues where that previous article left off. It explains the accelerating initiatives the AV-8B used to achieve SW-CMM Level 4 maturity in just another 16 months instead of the 50-month average reported by the Software Engineering Institute.

It is a business reality that most software projects are significantly behind schedule or never reach completion. According to a recent Standish Group Chaos Study [2], only 28 percent of all software projects finish on schedule, within budget, and contain all the features/functions originally specified.

This article describes how the Naval Air Systems Command's (NAVAIR) AV-8B Joint System Support Activity (JSSA) overcame those challenges by developing a strong process infrastructure based on two synergistic process improvement initiatives. Through those initiatives they surpassed their goals by reducing schedule variance by 90 percent and still achieved the measurable benefits of a Capability Maturity Model® for Software (SW-CMM®) Level 4 organization 60 percent faster than the average organization¹.

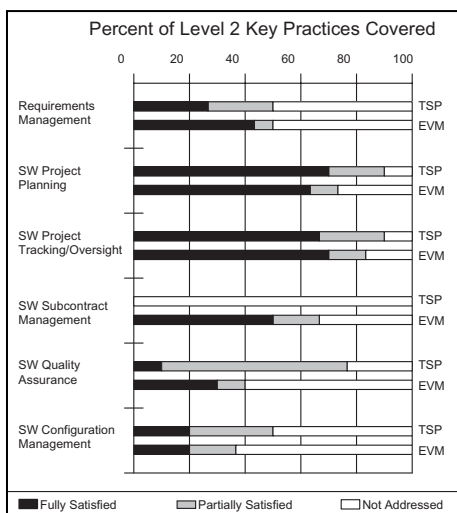
"The recipe for accelerating AV-8B's climb up the software maturity ladder and realizing the related benefits," says the AV-8B JSSA's leader Dwayne Heinsma, "centered around identifying champions and using process discipline as an enabler."

Those champions included the following:

- A Personal Software ProcessSM (PSPSM)/Team Software ProcessSM (TSPSM) champion leading the software team.

"In short, TSP was the singular reason why the AV-8B achieved a Level 4 rating in record time. The AV-8B's TSP implementation nearly fully satisfied all Level 4 key practices – all without needing a separate quantitative management plan or separate measurement group."

Figure 1: The AV-8B Analysis of How EVM and TSP Satisfied Level 2 Key Practice Areas



- An organizational process champion leading the development and the institutionalization of organizational standards.
- Senior managers championing the overall effort and removing roadblocks (establishing PSP/TSP as well as Earned Value Management [EVM] as the standard way of doing business at the JSSA).

SM Personal Software Process, Team Software Process, PSP, and TSP are service marks of Carnegie Mellon University.

- Most importantly, it took teamwork.

Setting the Foundations

The AV-8B integrates new capabilities into the Harrier aircraft for the U.S. Marine Corps and its allies, Spain and Italy. Like many other organizations, its primary process improvement goals are to reduce cycle time and increase quality. To help achieve these goals, the AV-8B implemented two complimentary process improvement initiatives – EVM and PSP/TSP.

EVM is a management technique that integrates cost, schedule, and technical performance. The AV-8B began its EVM journey in 1998. By the end of 2001, the AV-8B had successfully certified their EVM system based on the Department of Defense's stringent 32-point criteria². Capability mileposts along that road included documenting organizational standard processes for activities such as negotiating commitments; estimating, planning, and tracking all project work based on a standard work breakdown structure; assigning and communicating responsibilities; managing critical paths and resourced dependencies within and across projects; and taking corrective actions based on established thresholds.

The second significant process improvement initiative was the AV-8B's adoption of the TSP as its standard software process. The TSP is a high-maturity process for software teams developed by the Software Engineering Institute [3]. The AV-8B launched its first TSP new-development project at the beginning of 2001 followed by a second TSP maintenance project in mid-2002.

The TSP provided the software project teams a complete package of training, tools, processes, coaching, and mentoring.

From day one, these teams had a customizable framework with which to estimate, plan, track, communicate, and measure the quality of their software processes and work products. In addition, standard TSP roles established within each software team the responsibilities for communicating and coordinating software team activities with the larger AV-8B organization.

Measuring EVM/TSP Impact

In September 2002, the AV-8B conducted a SW-CMM Level 3/Level 4 CMM-based Appraisal for Internal Process Improvement (CBA-IPI). The assessment team had a secondary objective of analyzing the benefits of EVM and TSP on the AV-8B's software process maturity. To accomplish their objective, the assessment team flagged observations during the assessment that mentioned either EVM or TSP.

At the conclusion of the CBA-IPI, AV-8B's System Software Engineering Process Group (SSEPG) lead took those flagged observations and mapped each one back to a specific SW-CMM key practice it supported. Then, using her SW-CMM experience and professional judgment, the SSEPG lead independently determined which key practices were fully satisfied, partially satisfied (i.e., additional effort was needed), or were not at all satisfied by each EVM or TSP observation.

The next three sections illustrate the results of this analysis summarized at the key process area (KPA) level.

Impact on Level 2 Key Practices

The focus of SW-CMM Level 2 is on basic management processes. The AV-8B's EVM and TSP implementations satisfied the majority of Software Project Planning and Software Project Tracking and Oversight key practices, as illustrated in Figure 1. EVM and TSP also partially satisfied many other Level 2 key practices.

EVM satisfied the intent for all facets of a project through an institutionalized system of agreed-upon commitments, well-defined plans, documented methods for tracking actual performance against plans, procedures for making course corrections, and training to perform related tasks.

TSP provided those exact same capabilities at the software team level through a defined implementation strategy, a documented project initiation process called a *launch*, a similar replanning process called a *relaunch*, and a project status process performed weekly by TSP software teams. It is important to note that both EVM and TSP

use the earned value (EV) method of reporting progress, and that the software teams' EV was fed into the organizations EV to achieve overall project status measures.

EVM and TSP at the AV-8B only partially satisfied the remaining Level 2 KPAs. That is because neither EVM nor TSP provided specific training for these functional areas, defined functional-area activities or work products, or provided for independent quality assurance (QA) verifications. A noteworthy observation is that TSP partially satisfied the majority of software QA key practices through a TSP team role that served as a touch-point between the TSP team QA and the organizational QA. In addition, the AV-8B's EVM requirements are equally levied on its software subcontractors while TSP does not at all address subcontractor considerations.

Impact on Level 3 Key Practices

At Level 3, projects are expected to tailor a common set of documented and approved organization-wide management and engineering processes. As with Level 2, both

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EVM and TSP at the AV-8B did significantly contribute to partially satisfying most KPAs. At Level 3, however, neither EVM nor TSP fully satisfied many KPAs, as illustrated in Figure 2.

The scope of TSP, by design, is limited to software team practices. This limited scope is obvious when you look at the KPAs that have a wide organizational application such as Organizational Process Focus/Definition, Training Program, and Intergroup Coordination. However, TSP fully satisfied a majority of peer review key practices through its individual review and group inspection processes. TSP also provided processes for integrating management and engineering activities to fully satisfy some Integrated Software Management key practices, as well as processes and measures to ensure quality engineering as described in the software product engineering KPA.

While EVM is organizationally focused, its processes are primarily project management related. As a result, the AV-

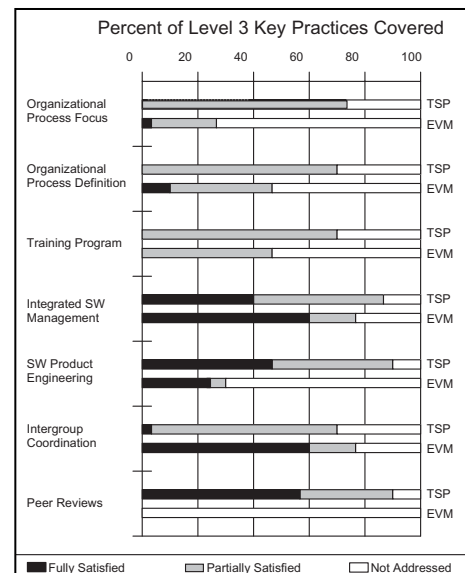


Figure 2: AV-8B Analysis of How EVM and TSP Satisfied Level 3 Key Practice Areas

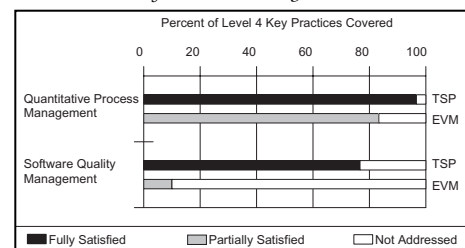
8B's EVM processes fully satisfied the majority of Integrated Software Management key practices. In addition, AV-8B's EVM guide was referenced as the organization's intergroup coordination plan. This guide provided standard processes for agreeing on commitments across teams and for identifying, tracking, and resolving intergroup issues.

Impact on Level 4 Key Practices

The focus of Level 4 is for projects to collect and use detailed measures for both process and product quality. EVM and TSP parted ways at the AV-8B at this level. In short, TSP was the singular reason why the AV-8B achieved a Level 4 rating in record time (see Figure 3). The AV-8B's TSP implementation nearly fully satisfied all Level 4 key practices – all without needing a separate quantitative management plan or separate measurement group. To the AV-8B, achieving Level 4 was not an effort but rather a natural evolution of using tools and techniques embedded in TSP.

As previously mentioned, TSP gave the software team the capability to understand and measure the quality of its software processes and work products from day one. Tracking and analyzing four basic TSP

Figure 3: AV-8B Analysis of How EVM and TSP Satisfied Level 4 Key Practice Areas



measures – size, time, defects, and completion dates – achieved this capability. In addition, TSP provided all the training, tools, and analysis procedures the software team needed to control and improve their processes using these measures. All that AV-8B needed to do in order to satisfy Level 4 KPAs was for the SEPG to fill in the organizational gaps. These gaps consisted of drafting policies, defining the organization's capability baseline, and identifying quality goals assigned to subcontractors.

EVM only indirectly supported the measurement of process quality and did not address product quality.

Realizing the Benefits

With EVM and TSP in place, and an open culture that encouraged taking qualified risks, the AV-8B rapidly enhanced its software process maturity. According to Chris Rickets, the AV-8B lead software engineer and TSP design manager, "Success came because of the team's ability to change paradigms by abandoning the old way of doing business and implementing PSP/TSP."

AV-8B software engineer and TSP Process Manager Dave Curry says, "The software engineers showed incredible discipline in using TSP and learning how it and other artifacts applied to the various CMM concepts. We had to change what we did to develop software. We had to change how we thought about developing software. TSP is a tool – the team made it work!"

"Without a doubt, having EVM in place to monitor cost and schedule was a major contributor," adds Katie Smith, an AV-8B software quality engineer, "along with management initiative and support for process improvement."

Team culture, champions for software process improvement, sound adherence to discipline and schedule, and full management support along with focusing on EVM and TSP are the factors that made it all happen. In terms of the analysis presented in this article, EVM at the AV-8B was primarily beneficial at lower maturity levels while TSP offered both high- and low-maturity benefits. The author would further expect to see the same analysis results repeated for Level 5 KPAs that were demonstrated for Level 4 (i.e., TSP benefits take center stage while EVM bows out).

The specific benefits of EVM and TSP at the AV-8B have been significant. In 1998, before implementing EVM, the AV-8B had a schedule variance of +30 percent. Once EVM was institutionalized,

schedule variance dropped to +18 percent. TSP further reduced that variance to +2.5 percent on a product with a defect density of 2.1 defect/thousand lines of code that could not be broken in system test.

What advice does the AV-8B team have for others contemplating such an effort? Brad Hodgins, the AV-8B Software Task Team lead, says, "You should plan on having someone committed to process improvement as their primary task."

"You want to start slowly, making small changes," advises Curry. "Let people adjust and find *their* way. A team that understands that is more willing to buy in."

Also, adds Rickets, "Don't expect this change to be easy or happen overnight. The change has to start at the management level first. Without their support it will not be successful."

As for the future, the AV-8B plans to transition process improvement to a new model, the Capability Maturity Model Integration (CMMI®), which integrates software engineering and systems engineering disciplines into a cohesive approach to process improvement. Heinsma is already visualizing future success for the AV-8B team. "We expect to be ready for our first formal CMMI assessment in a couple of years," he says.

With the continuing progressive teamwork evidenced by the AV-8B team, they will be ready. ♦

References

1. Hefley, B., L. Pracchia, and J. Schwalb. "AV-8B's Experiences Using the TSP to Accelerate SW-CMM Adoption." *CROSSTALK* Sept. 2002: 5-8 <www.stsc.hill.af.mil/crosstalk.2002/09/hefley.html>.
2. Johnson, J., K. Boucher, K. Connors, and J. Robinson. "Collaboration: Development & Management – Collaborating on Project Success." *Software Magazine* Feb./Mar. 2001 <www.softwaremag.com/archive/2001/feb/CollaborativeMgt.html>.
3. Humphrey, Watts S. *Introduction to the Team Software Process*. Boston: Addison-Wesley, 1999.

Notes

1. See the Software Engineering Institute's latest Maturity Profile Report at <www.sei.cmu.edu/sema/profile.html>.
2. Please see the Office of the Secretary of Defense Web site at <www.acq.osd.mil/pm> for information on earned value management and the 32-point criteria.

Additional Reading

1. Information on earned value management basics can be found at <www.acq.osd.mil/pm/evbasics.htm>.
2. Information on the Software Engineering Institute's Team Software Process can be found at <www.sei.cmu.edu/tsp>.
3. Davis, N., and J. McHale. *Relating the Team Software Process to the Capability Maturity Model for Software*. CMU/SEI-2002-TR-008. Pittsburgh: Software Engineering Institute, 2002.
4. Hefley, B., and L. Pracchia. "Accelerating SW-CMM Progress Using the TSP." Software Engineering Process Group Conference, Phoenix, AZ, Feb. 2002.
5. Crosby, L. "AV-8B JSSA Team Soars to Level 4." Naval Air Systems Command Press Release, Jan. 2003 <http://pao.navair.navy.mil/press_releases/index.cfm?fuseaction=press_release_view&Press_release_id=2016&site_id=16>.
6. Hefley, B., and L. Pracchia. "CMM + PSP/TSP → CMMI." Software Technology Conference, Salt Lake City, UT, Apr. 2003.

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